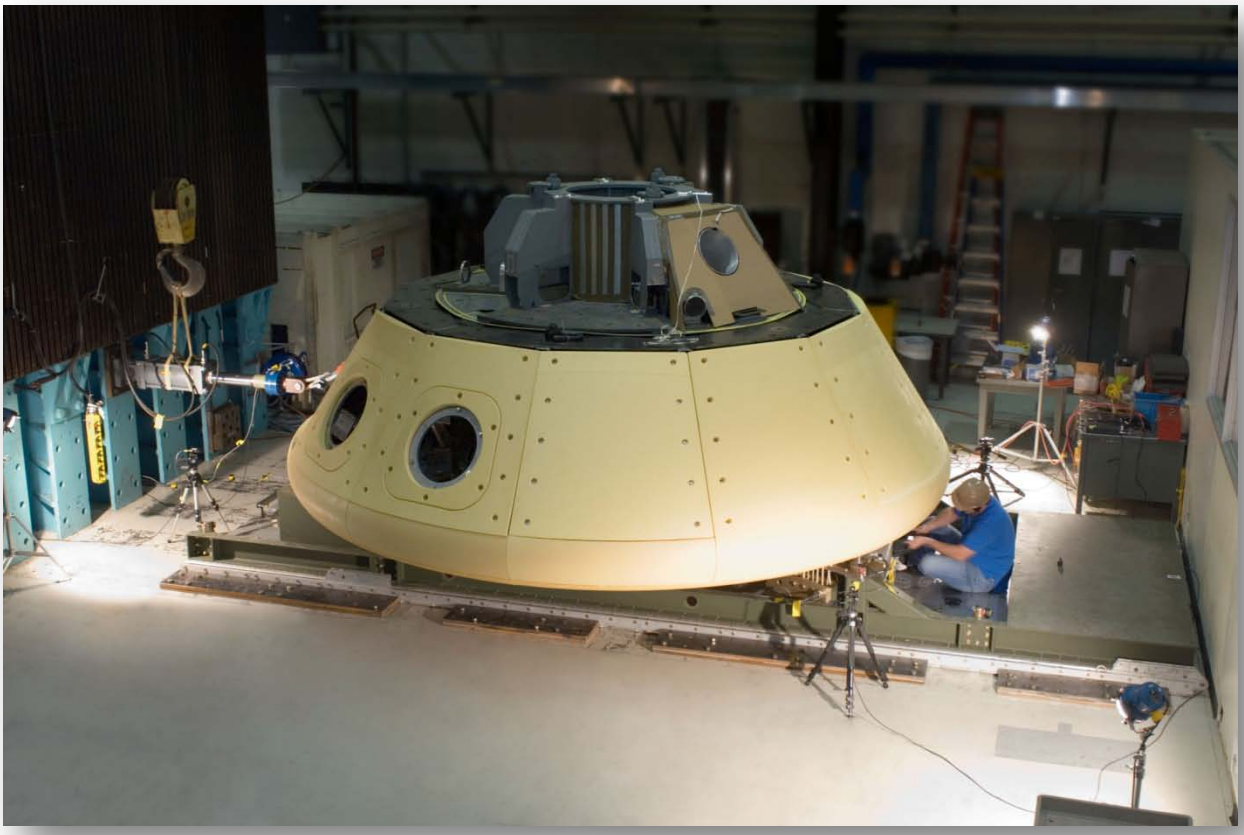
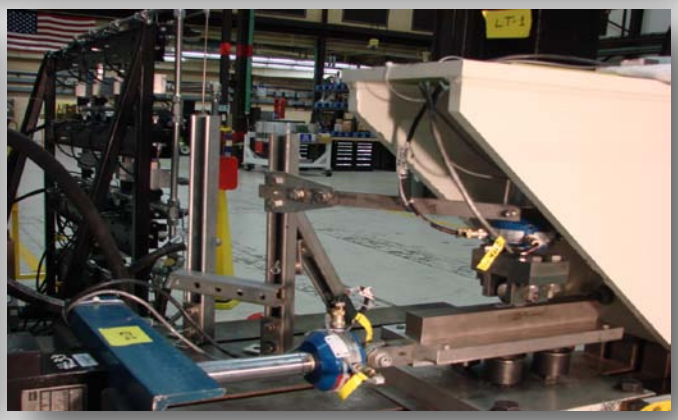
Structures Test Laboratory (STL)

User Test Planning Guide





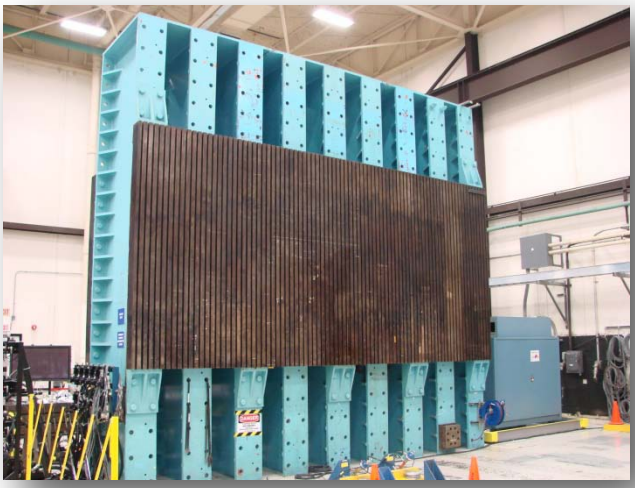
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

Table of Contents

1.0 Structures Test Laboratory

The Structures Test Laboratory (STL) in Johnson Space Center (JSC) Building 13 conducts static load testing of assemblies and components. Tests range from mechanical properties testing of materials to full-scale verification testing of payloads and spacecraft structures. The STL is equipped with a variety of hydraulic and electromechanical load frames with maximum load capacities ranging from 5 to 220 kip. Test operations also can easily accommodate rapid response research and development testing to support development of future technologies. The test capabilities of the STL have been developed and maintained to meet JSC's specific needs for anomaly resolution, flight qualification, recertification, engineering evaluation, and development. The lab's load control system is capable of managing up to 32 load control channels, and a PC-based data system provides the capability to record 256 data channels.

Services Provided
• Static and fatigue load testing using single or multiple actuators up to 220 kip • 12 load frames – Tension and compression testing – Load or displacement control – Metallics and composites • Cyclic testing up to 100 Hz • Fracture mechanics property testing – Automated da/dN testing • Tensile, lap shear, and compression testing of materials at low and elevated temperatures • Fatigue/fracture coupon tests



Strongback Wall

Point of Contact

Lab Manager, Chris Briggs
Johnson Space Center
2101 NASA Parkway Houston, TX 77058
(281) 483-9159
christopher.p.briggs@nasa.gov

Specifications

Facility

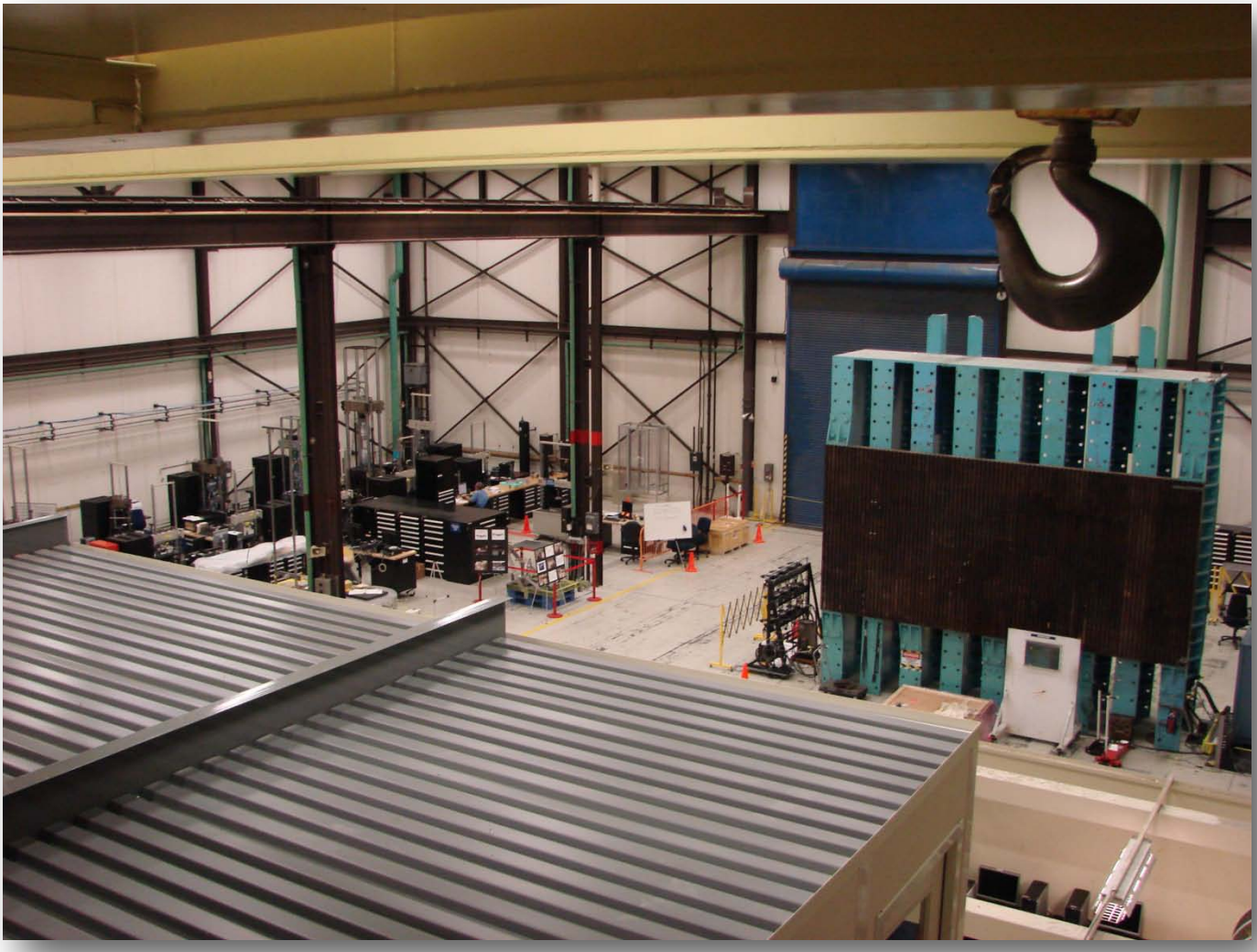
Type	Values
Facility	13,000 ft^2 with 39 ft ceiling (limited to 27 ft by overhead cranes)
Access	22 ft x 18 ft rollup door
Bridge Cranes	Two 20-ton and 5-ton cranes
Strongback Wall	20 ft x 21 ft 10 ft x 20 ft steel plates with T-slots on 3-inch centers are attached to each side of the strongback wall to permit attachment of heavy test fixtures
T-Slot Table	7,500 lb capacity to accommodate smaller-scale structural testing

Structural Testing

Type	Values
Load Frames	11 tension/compression load frames
Load Frame Capacities	5 – 220 kip
Load Control System	Aero ST Load Control System – Capability to manage up to 32 load and stroke control channels 1 portable load control system – 2 load and stroke control channels
Data System	256 data channels (1 – 1000 SPS) 1 portable data system – 40 data channels (1 – 100 SPS)
Instrumentation	Load cells Linear resistive deflection potentiometers Displacement/velocity transducers Linear variable differential transformer deflection transducers Rotational variable differential angular displacement transducers Thermocouples Force/load washers Pressure transducers Strain gages

2.0 Facility Layout

The STL is located within the high bay of JSC Building 13. The high bay area encompasses about 13,000 square feet of floor space with a 39-foot ceiling. Access is normally via a 22-foot-high by 18-foot-wide rollup door at one end of the high bay. Two bridge cranes are available for materials and test article handling. The STL is divided into a number of areas, each supporting a different aspect of static loads testing. These areas include two test bays for testing structural assemblies, a static load frame area, a central data acquisition room, a test article preparation area, a small machine shop, a tool crib, an office area, and storage areas.*



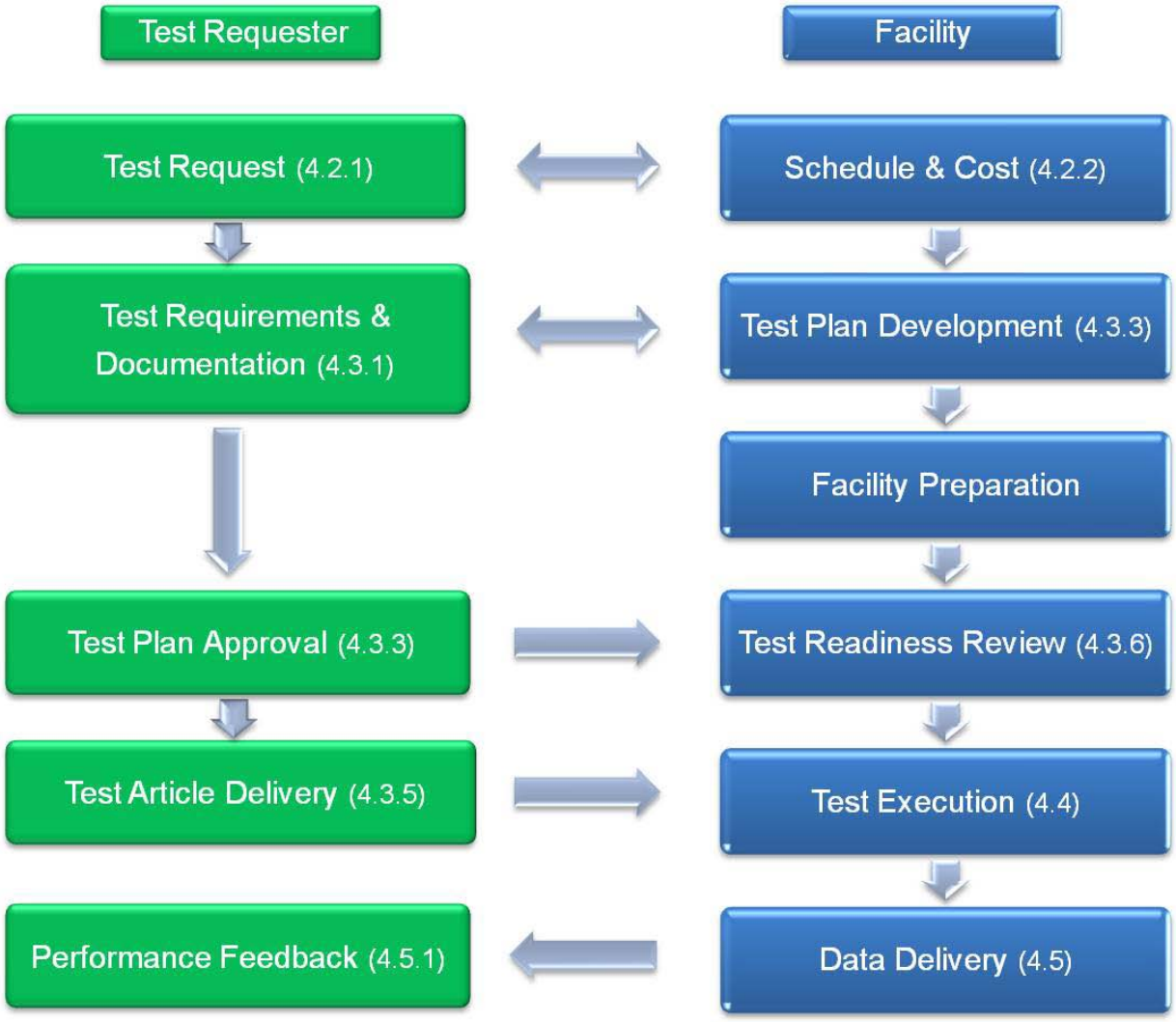
* See Appendix A for facility interfaces and the facility layout.

3.0 Safety and Health

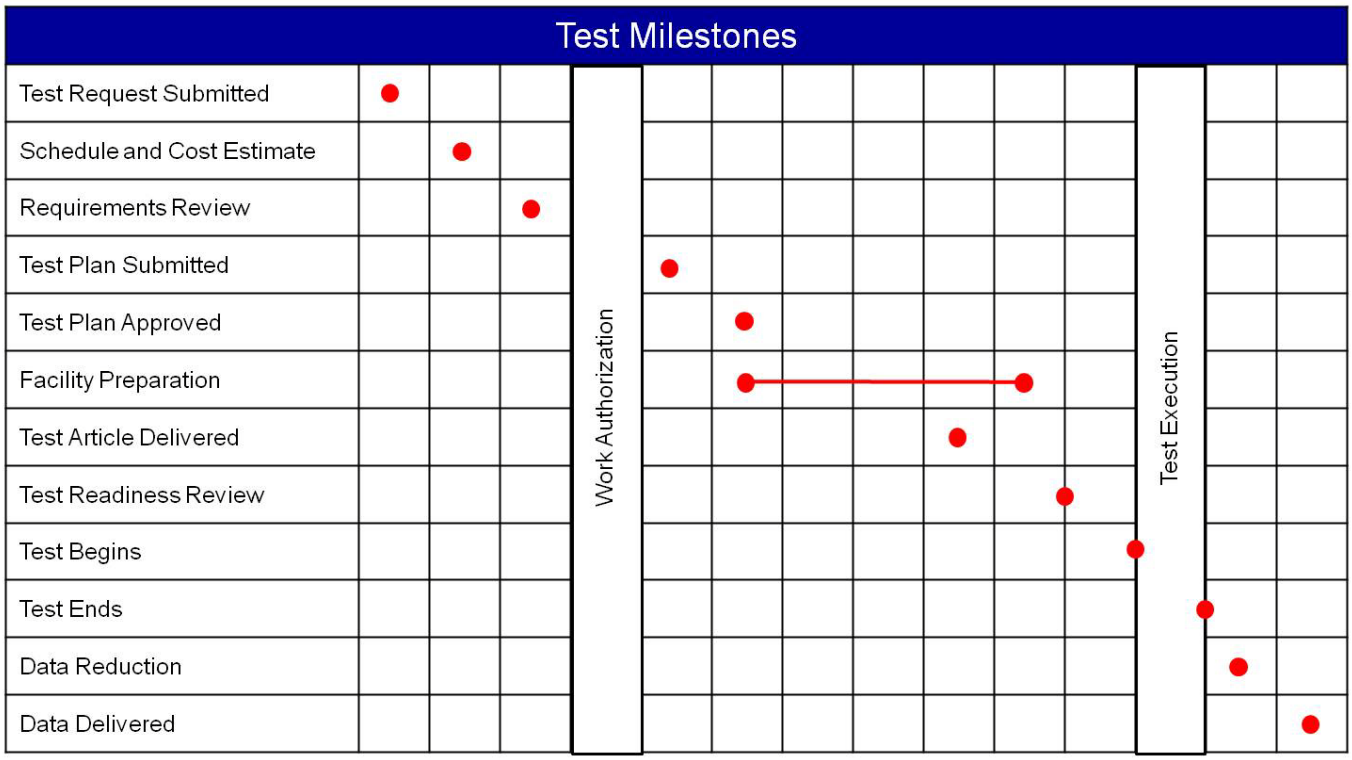
Safety is an integral part of the culture at the National Aeronautics and Space Administration (NASA). Management, leadership, and employee involvement from all organizations are critical to the success of NASA's safety program. In order to ensure personal safety and a safe test environment throughout the process, the requester shall furnish the facility with the information necessary to perform a hazard assessment of the test article. Additionally, while visiting JSC, the requester shall follow all facility-specific safety and health requirements. A facility safety briefing shall be provided to all personnel prior to the start of the test. The safety briefing will include a review of the STL safety rules, potential hazards, and emergency procedures.

4.0 Test Process Flow

The flowchart presented below outlines the basic roadmap and significant milestones between the initial test request and delivery of test data. The flow is separated between Test Requester actions and Facility actions. Interactions and inputs between the Test Requester and the facility Test Director also are highlighted.



The test schedule is highly dependent on the complexity of the test, facility availability, and sequence of runs. A detailed schedule shall be developed following a review of the test objectives and requirements. For time-critical testing, this schedule may be accelerated. Major milestones are presented below:



4.1 Export Controlled and Proprietary Information

The STL provides for protection of export controlled and proprietary information and hardware throughout the test process. The Test Requester shall clearly mark all export controlled or proprietary hardware items and data provided with a notice of restriction on disclosure or usage. The Test Director shall safeguard export controlled or proprietary items from unauthorized use and disclosure and ensure that test articles remain secure within the facility and are properly sequestered. Hardware items shall be returned to the Test Requester or disposed of in accordance with the Test Requester's instructions at the completion of the test activity.

4.2 Test Initiation Phase

The test initiation phase establishes the relationship between the Test Requester and the Test Director. The Test Requester shall provide a test request to the Test Director, which will be used to determine test feasibility and to develop an estimated cost and a preliminary test schedule. An initial requirements review shall define the characteristics of the test article, test objectives, and special considerations for the test. An onsite tour of the facility is highly recommended for familiarization and to provide an opportunity for an exchange of technical information.

Inputs:	Test Requester provides test request, identifies Test Article Expert
Activities:	Facility Test Director reviews test request to determine test feasibility
Outputs:	Facility delivers preliminary test plan, estimated cost, and schedule to Test Requester

4.2.1 Test Request

The test request outlines the test objectives, test article description, and schedule. A Test Request Worksheet is provided in Appendix B. This worksheet addresses the basic requirements for testing in the STL. It is suggested that the Test Requester complete this worksheet to facilitate the development of a preliminary test plan. Contact the Test Director if you have questions about completing the Test Request Worksheet. At a minimum, the test request should include the following information:

Test Objective

A brief description of the test requirements, including, but not limited to, the following:

- Desired test conditions (load/displacement, temperature)
- Proposed test approach
- Test data requirements

Test Article Description

A brief description of the test article, including, but not limited to, the following:

- Size (provide drawings, sketches, photos)
- Weight
- Test article interface (load points, method of suspension or test article support)
- Test article fluid interface requirements (type, pressure, flow)
- Orientation (fixed or moveable)

- Special considerations [e.g., hazards, cleanliness, compatibility, material safety data sheets (MSDS)]
- Handling and storage requirements

Schedule

Identify the required start date and proposed date for test completion.

4.2.2 Schedule and Cost Estimate

A cost and schedule estimate, including major milestones, will be delivered following receipt of the Test Request Worksheet.

4.3 Test Preparation Phase

The detailed test plan and test schedule are finalized during the test preparation phase. The Test Requester shall provide detailed test requirements and test article documentation to the Test Director. A Test Readiness Review (TRR) will be held following approval of the test plan.

Inputs:	Test Requester provides test requirements and test article documentation
Activities:	Facility develops test plan, begins assembly of facility interface/support structure(s)
	Test Requester ships/transports test article to JSC
Outputs:	Test Requester approves test plan and test schedule
	Facility holds TRR

4.3.1 Test Requirements

A complete understanding of test requirements is mandatory for a successful test. Test requirements must be defined and reviewed so that the test team understands the effect of the requirements on test facility preparation. The Test Requester shall provide a detailed list of test requirements, including, but not limited to, the following:

- Specific test conditions
- Interface requirements (e.g., fluid, structural, electrical, mechanical)
- Data/instrumentation requirements (provided by Test Requester and facility)

4.3.2 Test Article Documentation

Test Article Drawings

The Test Requester shall provide detailed test article drawings as requested by the facility. Test article drawings are used to prepare the facility interfaces, test article support structures, and instrumentation connection points.

Material Safety Data Sheets

NASA must ensure that all materials exposed to test environments do not present a hazard to personnel or the test facility. The Test Requester shall deliver to the facility MSDS for materials used in the construction of the test article with an assessment of expected byproducts produced during the test. The MSDS shall be delivered prior to delivery of the test article. The Test Director will review the materials list for compatibility with the test environment and to determine protective measures for personnel, if required.

Test Article Hazard Identification

The safety of facility personnel, facility equipment, and the test article is imperative to NASA. Potential hazards, material compatibility, and facility interfaces will be reviewed with the facility prior to testing. In certain instances, special precautions must be taken, due to the severity level of these potential hazards. The Test Requester may be asked to provide further information to clarify or mitigate a potential hazard. It is highly recommended that the Test Requester provide a test article hazard analysis or complete the Test Article Hazard Checklist included in Appendix B. The analysis should consider test article handling, support equipment, potential failure modes during the test, hazardous materials, batteries, high voltage/current devices, pressurized components, dangerous mechanical devices, sharp edges, and any other potential hazards.

4.3.3 Test Plan

A test plan will be prepared by the Test Director, unless one is submitted by the Test Requester. The final test plan shall be approved by the Test Requester with concurrence from the Test Director. The test plan will be the controlling document, with respect to scope and approach for the test program. The test plan will include, at a minimum, the test objectives, scope, test article description, safety considerations, and data requirements. Changes to the test plan that occur after the TRR that result in a major change to the scope of the test or that present new hazards may require a delta TRR. A test plan template is included in Appendix D.

4.3.4 Test Schedule

A detailed schedule shall be developed by the Test Director and approved by the Test Requester. The schedule shall allow adequate time for review and approval of test requirements, assembly of facility interfaces/structures, and delivery of the test article. The schedule of other tests and maintenance activities will be reviewed and potential conflicts shall be addressed by the Test Director.

4.3.5 Test Article Delivery

The test article delivery date will be determined on a case-by-case basis. An agreed-upon delivery date shall be captured as a milestone in the test schedule. The Test Requester shall provide detailed handling instructions prior to delivery of the test article, including handling hazards, cleanliness, and storage requirements. An inspection of the test article shall be performed by the Test Director and the Test Article Expert prior to the start of testing. NASA encourages Test Article Expert participation in the test article integration phase to provide immediate feedback on test article handling and on any integration issues that arise.

4.3.6 Test Readiness Review

A TRR will be held to ensure the completion of all necessary facility and test article activities prior to test execution. The TRR will include the following:

- Review of the test plan, test procedures, and other required test documentation
- Confirmation of facility and test article readiness
- Review of configuration records, including facility interface control documents, pressure system certification, instrumentation calibration, and materials compatibility
- Assurance that controls are in place to mitigate risks or hazards identified in the Test Article Hazard Analysis
- Verification that data acquisition and processing functions are in place to adequately capture all critical data
- Confirmation that multimedia coverage is adequate to provide recognition and assessment of potential test anomalies

Approval to proceed with test operations is granted by the Test Readiness Review Board (TRRB). The Test Director shall ensure that all TRR actions have been accomplished prior to the start of the test. The TRRB shall convene 1 to 5 business days prior to the start of the test. TRRB participants shall include the following:

NASA TRRB Chairman	Test Article Expert (Appointed by Test Requester)
Test Director	Safety Engineer
NASA Test Safety Officer	Quality Engineer – if required by facility

4.4 Test Execution Phase

NASA encourages Test Requester participation in the testing activity. The Test Requester shall provide a Test Article Expert to verify that test setup and execution meet the stated objectives. The Test Article Expert also shall verify test article performance and approve requested test deviations during test operations.

Inputs:	Approval to begin testing received from TRRB
Activities:	Facility completes facility buildup, Detailed Test Procedure
	Facility conducts testing activity
Outputs:	Test completed

4.4.1 Test Authority

The Test Director has the authority and responsibility to direct the test in accordance with the approved test plan and to terminate test activities per test rules when danger is imminent or test control cannot be maintained. The Test Director will ensure that positive actions are taken to halt any steps in the test procedure whenever unsafe or hazardous test conditions arise. The Test Director, with the concurrence of the Test Article Expert, has the authority to terminate the test when sufficient data has been obtained to meet objectives or when objectives cannot be met. Test team personnel will accept directions only from the Test Director.

4.4.2 Test Deviations

Changes to the test procedure shall be approved by the Test Article Expert with concurrence from the Test Director. Deviations that result in a major change to the scope of the test or that present new hazards may require a delta TRR.

4.5 Test Closeout Phase

Data shall be delivered to the Test Requester within 10 business days following completion of testing. The Test Requester shall notify the Test Director upon receipt of the data. Acceptance of the test data concludes the test activity.

Inputs:	Test completed
Activities:	Facility ships/transports test article to Test Requester
	Test Director delivers data to Test Requester
Outputs:	Test Requester accepts data
	Test Requester completes Customer Feedback form

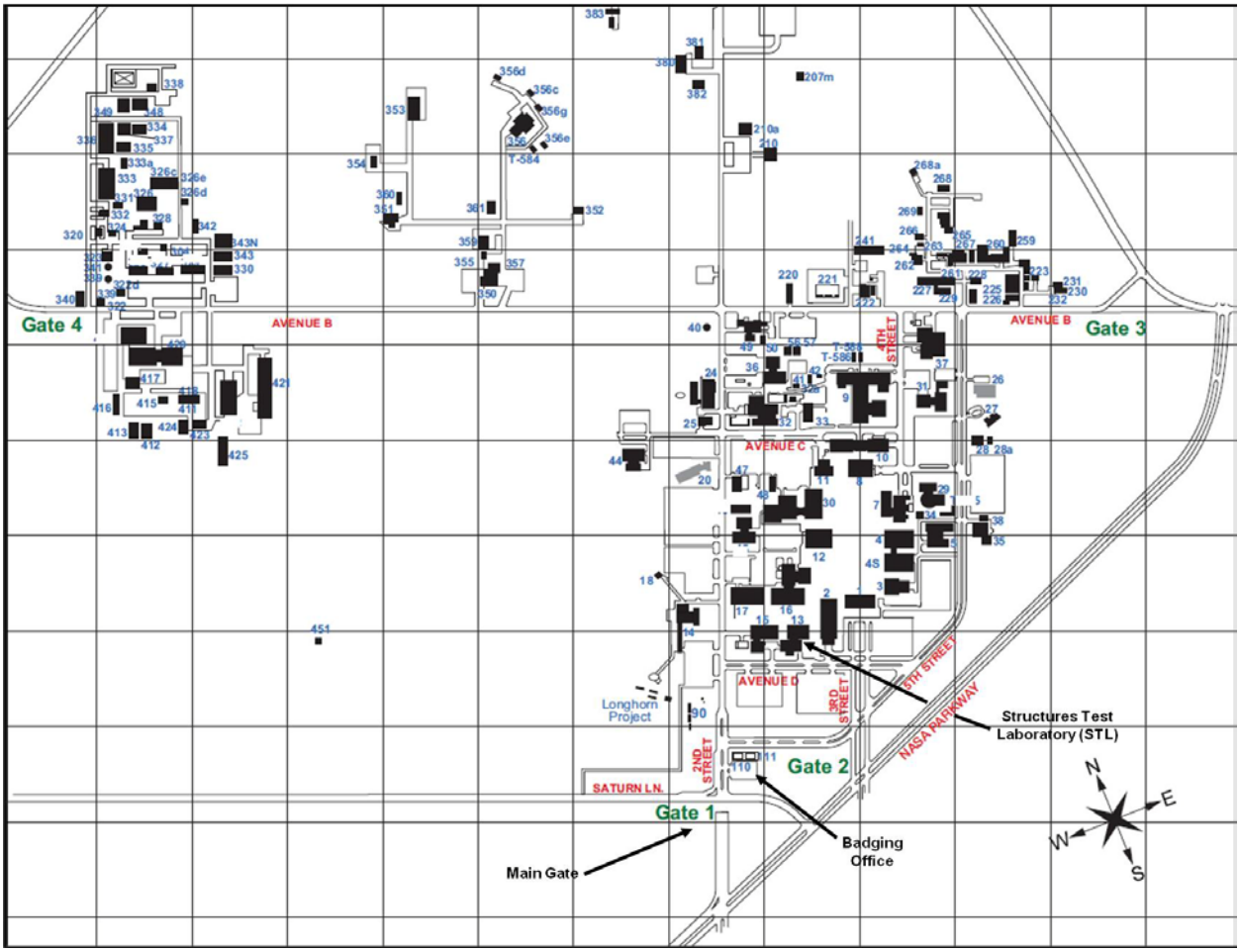
4.5.1 Customer Feedback

The STL requests feedback from our customers. Evaluation of the services we provide enables continued improvement to our process. A Customer Feedback form is included in Appendix E. You are encouraged to complete the Customer Feedback form and return it to the Test Director, following receipt of the test data. Your participation is greatly appreciated.

5.0 Facility Access

Identification badges are required for all persons requiring access to JSC. The Test Director or designee will initiate a badge request for all Test Requester personnel who will be participating in the test activity. Badge requests must be submitted at least 4 days prior to the visit to prevent badge processing delays. Badge requests for non-U.S. citizens may require a minimum of 30 business days to process. Test Requester personnel shall arrive at JSC Building 110 to pick up temporary identification badges. Visitors to JSC must show a current picture identification (valid driver's license, U.S. passport, government ID card).

The STL is located in JSC Building 13. A facility access briefing shall be provided to all personnel requiring access to the facility prior to the start of the test.



6.0 Roles and Responsibilities

Test Director – Has overall responsibility for all phases of the test process.

Test Requester – The client requesting performance of a test activity. The Test Requester is responsible for the test article and for providing a Test Article Expert.

Test Article Expert – A representative of the Test Requester with thorough knowledge of the test article and how it is to be operated in the test environment. The Test Article Expert also is responsible for approving the test plan and verifying that test objectives are met.

Test Conductor – Assigned under the authority of the Test Director to execute the test in accordance with the approved test plan.

Safety Engineer – Reviews the Test Article Hazard Checklist and the integrated hazard analysis for the test facility to identify any additional hazards that could result in injury to personnel.

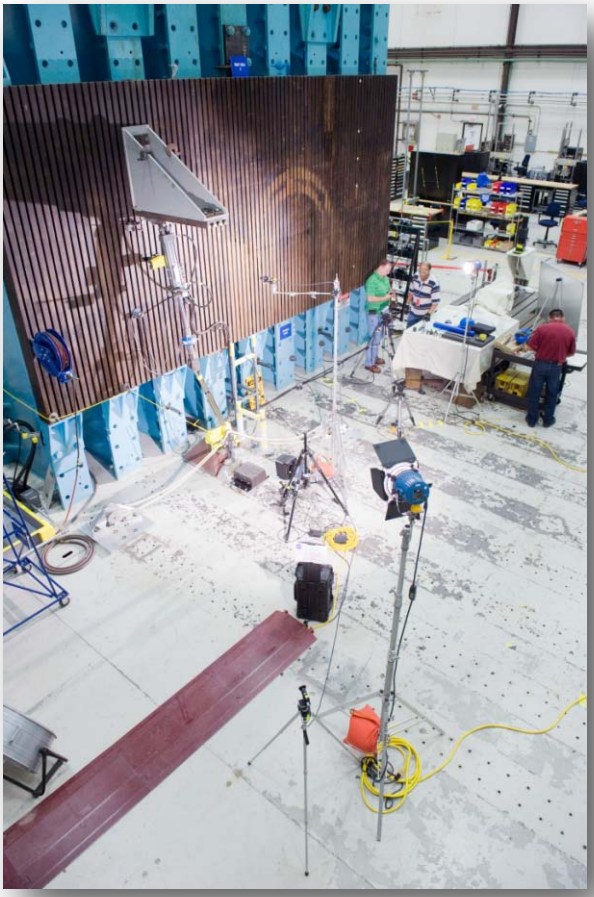
Quality Engineer – Responsible for verifying that the test facility is ready for the test by ensuring that all constraints to the test have been closed.

Responsibilities Matrix

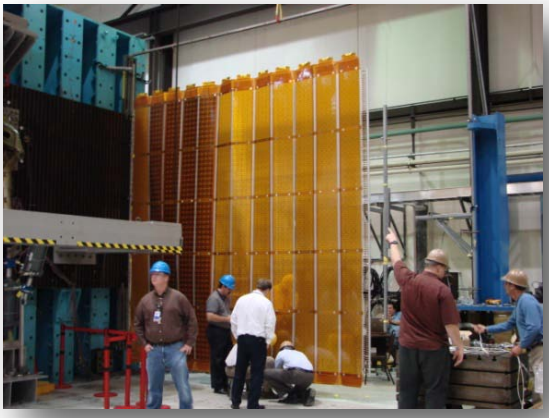
Item	Test Requester	Facility
Test Request Worksheet	Create	Review and provide assistance as needed
Cost and schedule	Approve	Create and sign off
Hazards	Identify test article hazards	Create test article/facility integrated hazard analysis
Test plan	Review and approve	Create and sign off
Test Readiness Review	Approve	Conduct and approve
Test execution	Verify test article performance Verify that test setup and execution meet objectives Approve requested deviations	Execute test
Provide test data/results	Notify Test Director of data receipt	Deliver to Test Requester
Review test data/results	Approve	
Shipping	Provide instruction	Execute per request

Acronyms

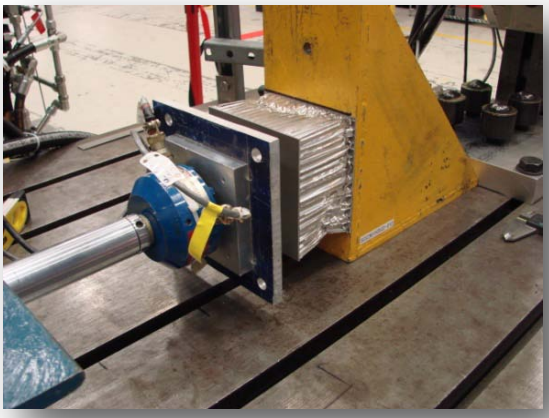
CPAS	CEV Parachute Assembly System
ISS	International Space Station
JSC	Johnson Space Center
LVDT	Linear Variable Differential Transformer
MSDS	Material Safety Data Sheets
NASA	National Aeronautics and Space Administration
SPS	Samples Per Second
STL	Structures Test Laboratory
TRR	Test Readiness Review
TRRB	Test Readiness Review Board
TVIS	Treadmill with Vibration Isolation and Stabilization
UCCAS	Unpressurized Cargo Carrier Attachment System



CPAS Extraction Force Transfer Coupling Binding Test



ISS Solar Array Test



Compression of Aluminum Pads

Appendices

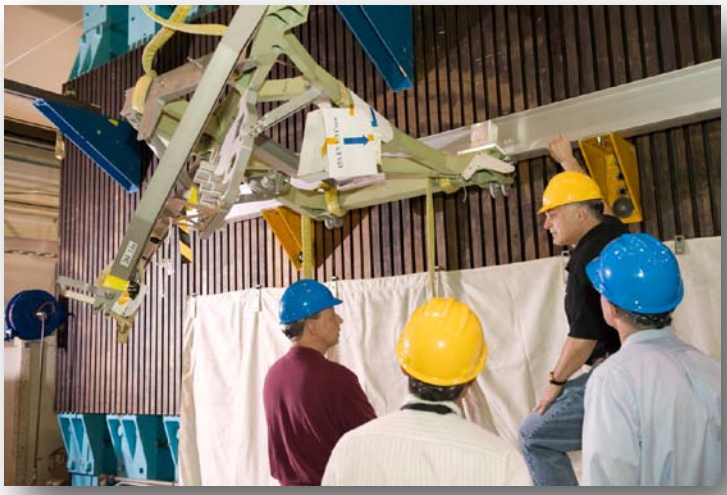
A. Facility Interfaces

B. Test Request Worksheet

C. Instrumentation Provided by Facility

D. Sample Test Plan

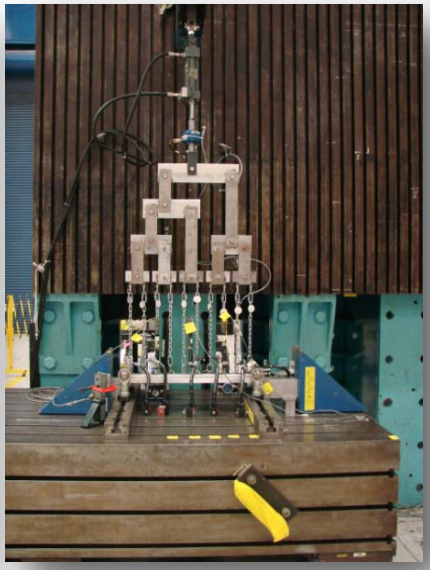
E. Customer Feedback



ISS UCCAS Deployment Checkout

WB-57 Landing Gear Strength Test

TVIS Bungee System Test

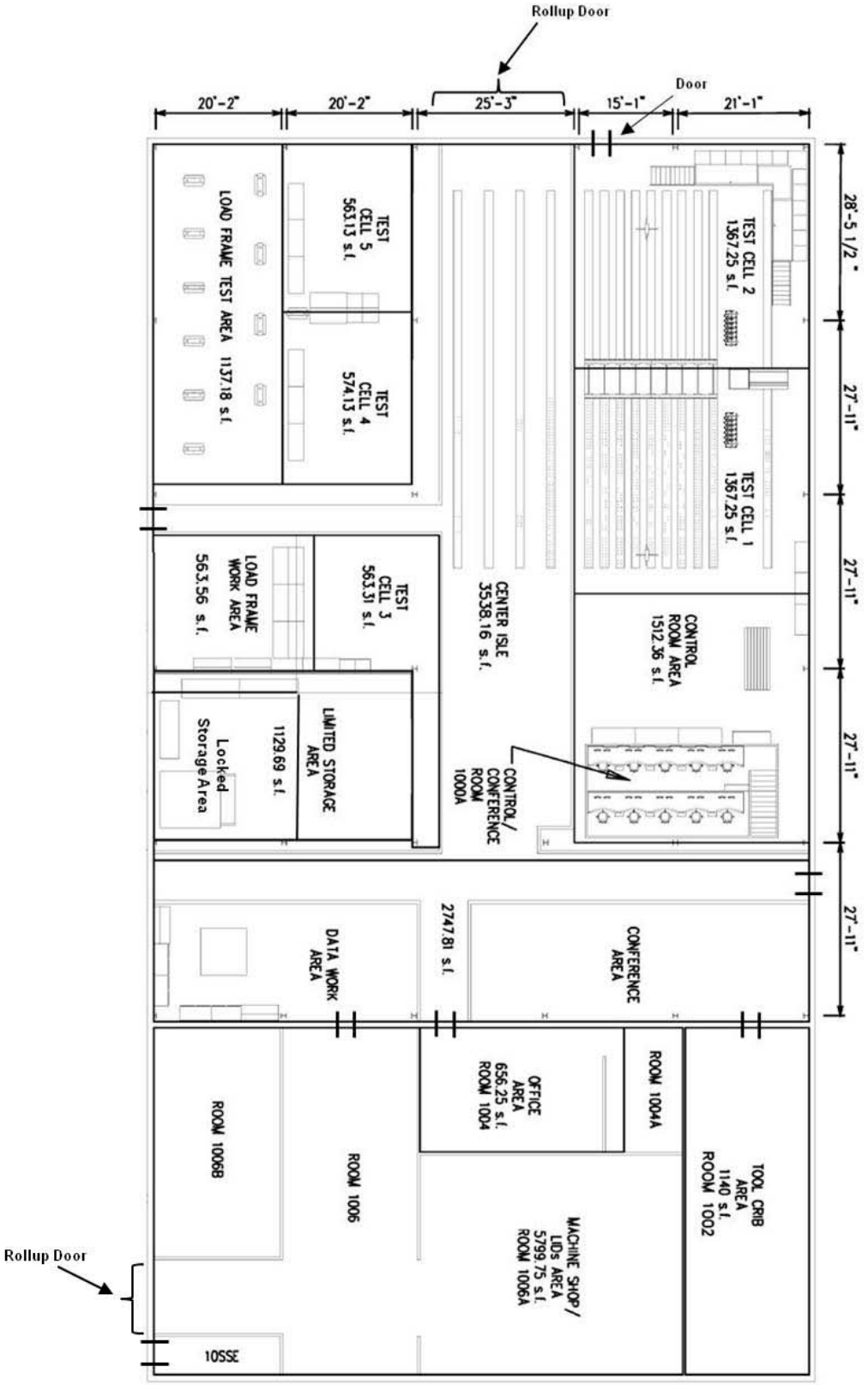


Shuttle Window Beam Stiffness Test

Orion Volume F Cover Load Testing

Appendix A Facility Interfaces

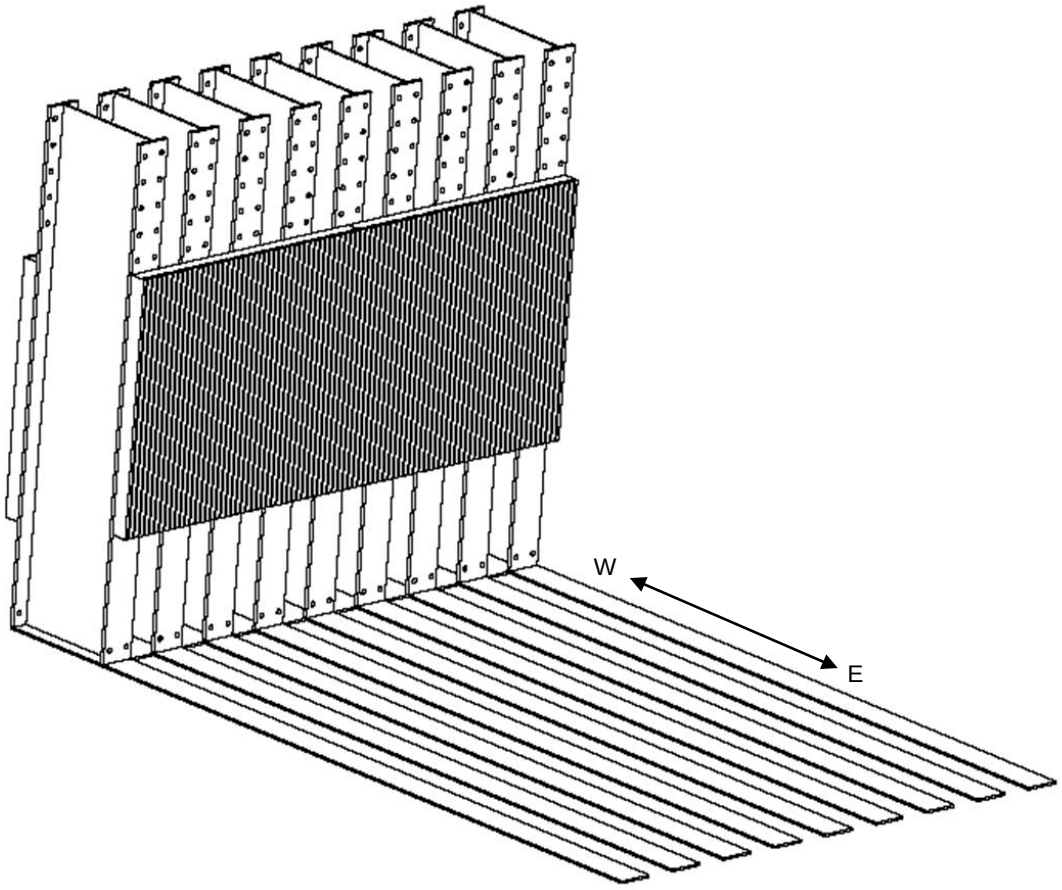
Facility Layout



The test fixture models/images included in this guide are a sampling of the capabilities within the STL. The facility maintains a variety of fixtures to support general and requester-specific testing. Additional test fixtures are available upon request. The facility also can manufacture test fixtures to requester specifications. Contact the Test Director to discuss test article interface requirements.

Strongback

A structural steel strongback, 21 feet 4 inches wide by 20 feet high by 5 feet thick, serves as a rigid attach point for cantilevered structural tests or as an anchor for built-up test fixtures. The strongback is composed of nine steel I-beams embedded into 6.5 feet of concrete. Three-inch-thick steel plates with vertical 7/8-inch T-slots on 3-inch centers are attached to the east and west faces of the vertical strongback. Nine steel built-up I-beams imbedded in the floor are rigidly attached to the strongback and extend 27 feet 11 inches in both the east (E) and west (W) directions from the faces of the strongback on 2-foot-6-inch centers. The vertical strongback separates the two test bays. CAD models and hole patterns of this model with dimensions can be provided upon request.



CAD Model of Strongback

Load Frames

The STL has the following closed-loop, servo-hydraulic, tension/compression, and electromechanical test equipment for performing mechanical property evaluations of materials and structural loading of components and systems. All of these systems can be operated in either load or displacement control.

220 kip Test System

The test system has a 220,000-pound nominal capacity, with a maximum vertical opening of 81 inches, minus grips, and 28 inches between columns. The grips are hydraulic and self-aligning, and they can accept a specimen up to 4 inches wide by 2.5 inches thick. The system has a cyclic capability up to 5 Hertz (dependent upon stroke).

110 kip Test System

The test system has an 110,000-pound nominal capacity, with a maximum vertical opening of 63 inches and 24 inches between columns. The grips are hydraulic and self-aligning, and they can accept a specimen up to 3 inches wide by 3/4 inch thick. The system has a cyclic capability up to 6 Hertz (dependent upon stroke).

110 kip Test System

55 kip Test System (Servo-Hydraulic), 2 Each

The test system has a 55,000-pound nominal capacity, with a maximum vertical opening of 65 inches between grips and 25 inches between columns. The grips are hydraulic and self-aligning, and they can accept a specimen up to 4 inches wide by 3/4 inch thick. The system has a cyclic capability up to 60 Hertz, (dependent upon stroke).

22 kip Test System (Servo-Hydraulic), 2 Each

The test system has a 22,000-pound nominal capacity, with a maximum vertical opening of 48.5 inches, minus grips, and 20 inches between columns. The grips are hydraulic and self-aligning, and they can accept a specimen up to 1.5 inches wide by 3/4 inch thick. The system has a cyclic capability up to 60 Hertz, (dependent upon stroke).

22 kip Test System (Servo-Hydraulic)

The test system has a 22,000-pound nominal capacity, with a maximum vertical opening of 87.5 inches, minus grips, and 21 inches between the columns. The grips are hydraulic and self-aligning, and they can accept a specimen 1-1/2 inches wide by 1/2 inch thick. The system has a cyclic capability up to 90 Hertz, (dependent upon stroke).

22 kip Test System

11 kip Test System (Servo-Hydraulic), 3 Each

The test system has an 11,000-pound nominal capacity. The system has a 21-inch-wide by 37-inch-high internal clearance.

5.5 kip Test System (Servo Hydraulic)

The test system has a 5,500-pound nominal capacity. The system has a 21-inch-wide by 37-inch-high internal clearance.

45 kip Test System (Electromechanical)

The test system has a 45,000-pound nominal capacity, with a crosshead travel of 46 inches and 22 inches between columns. Crosshead speeds reach up to 20 inches per minute, dependent upon load.

Electromechanical Load Frame

Test Article in Electromechanical Load Frame

Fabrication

The STL also houses a small machine shop to support in-house fabrication of load frame fracture mechanics test samples. The equipment within this machine shop includes drill presses and a computer numerical control mill, vertical/horizontal mill, wire electrical discharge machine, programmable control surface grinder, bandsaw, power hacksaw, wheel grinder, and sander.

Manual Vertical Mill

Computer Numerical Control Vertical Mill

Utilities

The STL can provide power to test articles and support equipment. Standard electrical power for the facility includes the following:

- 110 Volt AC, 60 Hz
- 208 Volt AC, 60 Hz, 1 Phase
- 208 Volt AC, 60 Hz, 3 Phase
- 240 Volt AC, 60 Hz, 3 Phase
- 440 Volt AC, 60 Hz, 3 Phase

Shop air at 150 psig is available throughout the high bay. The lab has one 90 gpm and one 70 gpm hydraulic power supply.

Liquid Nitrogen (LN2) is available in portable and fixed facility dewars for thermal cooling operations.

Potable water is available throughout the laboratory for cooling equipment and for test purposes.

Appendix B Test Request Worksheet

Test Requester Information

Test Article Expert:	Contact Information (Phone, E-mail, Address):

Test Objectives

Purpose of Test:

Test Article

Test Article Description:	
Physical Dimensions (L/W/H):	Weight:

Test Article Handling Requirements

Cleanliness Level:	Controlled Access:
Special Moving/Handling:	

Test Environment

Complete the Test Environment table below for steady state conditions or provide a plot of the test environment to be simulated for a continuous environment.

	Load Case 1 ☐	Load Case 2 ☐	Load Case 3 ☐	Load Case 4 ☐	Load Case 5 ☐
No. of Loadtrains					
Load/Displacement Control					
Maximum Load/Displacement					
Load/Displacement Increments					
Ramp Rate					
Hold Time					
Wave Form					

Operation Limits

Inner Upper Limit					
Inner Lower Limit					
Outer Upper Limit					
Outer Lower Limit					

Percent Error Limit

Inner Upper Limit					
Inner Lower Limit					
Outer Upper Limit					
Outer Lower Limit					

* Data is only required in each column where the parameter is significant to your desired test environment.

Test Article Interface

	Load Case 1 ☐	Load Case 2 ☐	Load Case 3 ☐	Load Case 4 ☐	Load Case 5 ☐
Design					
Component Models					
Assembly Models					
Drawings					
Comments:					
Fabrication					
Component Hardware					
Comments:					
Test Buildup					
Comments:					
Requester Supplied Items					
List materials, instruments supplied by Test Requester:					

Operational Requirements

Proposed Test Start Date:	Critical Test Start Date:
Quality Support (Yes/No):	

Data Acquisition and Recording

Number of Channels:	Video Recording (Yes/No):
Sampling Rates:	Photographic Film (Yes/No):
Real-Time Data Processing (Yes/No):	High Speed/Low Speed:
Data File (ASCII/Excel):	Plots (Yes/No):

Data

Temperature ☐	Load ☐	Deflection ☐	Pressure ☐	Time ☐	Strain ☐

Instrumentation Provided by Test Requester:

Designs/Drawings

We can accept files through a File Transfer Protocol (FTP) site, by e-mail, or via standard mail.

1. E-mail drawings to christopher.p.briggs@nasa.gov.
2. The Test Director will send an invitation to the NASA FTP site to upload and send files.
3. Mail drawings to National Aeronautics and Space Administration, Attention Chris Briggs, Mail Code ES4, Lyndon B. Johnson Space Center, Houston, TX 77058

Other Information

List any other information pertinent to the test:

Test Article Hazard Checklist

A hazard analysis statement is required for any of the following applicable attributes of any of your provided hardware (e.g., test article, support equipment).

Hazard	Y	N	Comments
Mechanical	☐	☐	
Handling (> 40 lb or > 4 ft in any dimension)	☐	☐	
Instability	☐	☐	
Sharp Edges	☐	☐	
Pinch Points	☐	☐	
Exposed Mechanisms (e.g., rotating, reciprocating)	☐	☐	
Pressure Systems	☐	☐	
Stored Energy (e.g., springs, weights, flywheels)	☐	☐	
Ejected Parts, Projectiles	☐	☐	
Electrical	☐	☐	
Voltage (> 50 volts)	☐	☐	
Batteries	☐	☐	
Generation/Storage (e.g., coils, magnets, capacitors)	☐	☐	
Electrostatic Sensitive Devices	☐	☐	
Thermal	☐	☐	
Hot Surfaces (> 113 ^{o}F, 45 ^{o}C)	☐	☐	
Heaters	☐	☐	
Cold Surfaces (< 39 ^{o}F, 4 ^{o}C)	☐	☐	
Cooling Devices	☐	☐	

Hazard	Y	N	Comments
Radiation	☐	☐	
Ionizing	☐	☐	
Non-Ionizing	☐	☐	
Laser	☐	☐	
Microwave	☐	☐	
Infrared (IR)	☐	☐	
Ultraviolet (UV)	☐	☐	
Radio Frequency (RF)	☐	☐	
Visible Light, High Intensity	☐	☐	
Material	☐	☐	
Uncontained Brittle Materials	☐	☐	
Test Environment Incompatibility	☐	☐	
Contained Fluids	☐	☐	
Toxic, Corrosive, Flammable Fluids	☐	☐	
Biohazards	☐	☐	
Miscellaneous	☐	☐	
Noise Level (> 85 dBA)	☐	☐	
Ultrasonic	☐	☐	
Pyrotechnics/Explosives	☐	☐	

Appendix C Instrumentation Provided by Facility

Instrumentation	Range
Load Cells	50 – 200,000 lb
Load Washers	2,000 – 50,000 lb
Position Transducers	Linear Variable Differential Transformer (LVDT): ± 0.05 – ± 1 in String Pots (Linear Resistive Deflection Potentiometers): 2 – 500 in Displacement/Velocity: 10 in, 50 in, and 500 in Dial Indicators: 0.1 – 2 in
Torque Transducers	20 – 350 lb/ft
Pressure Transducers	1 – 20,000 psi
Strain Gages	Various; installation by certified personnel
Thermocouples	Type T, K, J; 300 – 2300F

Appendix D Sample Test Plan

Test Requester Information

Test Article Expert:	Contact Information (Phone, E-mail, Address):
[Identify Test Article Expert]	[Test Article Expert Contact Information]

Test Objectives

Purpose of Test:

Define Purpose of Test:

Sample Objective: Test two assemblies to a load of 500 lb that will be held for 3 minutes. The assembly is purely mechanical and is not powered or pressurized. Load will be recorded continuously for the duration of the test.

Test Article

Test Article Description:

Describe Test Article (e.g., contents, type of material)

The assemblies consist of an aluminum hub of approximately *X*" in length and *X*" in diameter. Attached to the assembly is a *X*" diameter nylon-coated steel cable that is approximately *X*" long.

Physical Dimensions (L/W/H): *X*" in length and *X*" in diameter	Weight: 20 lb

Test Article Handling Requirements

Cleanliness Level:	Controlled Access:
N/A	N/A

Special Moving/Handling:

Describe any special handling requirements

Sharp edges, to be transferred to facility by Test Requester.

Test Environment

Complete the Test Environment table below for steady state conditions or provide a plot of the test environment to be simulated for a continuous environment.

	Load Case 1	Load Case 2	Load Case 3	Load Case 4	Load Case 5
	X	X	☐	☐	☐
No. of Loadtrains	N/A	N/A			
Load/Displacement Control	Load Control	Load Control			
Maximum Load/Displacement	+500 lb	+ 500 lb			
Load/Displacement Increments	None	None			
Ramp Rate	15 lb/sec	15 lb/sec			
Hold Time	2 min	2 min			
Wave Form	Ramp	Ramp			

Operation Limits

Inner Upper Limit	N/A	N/A			
Inner Lower Limit	N/A	N/A			
Outer Upper Limit	+ 550 lb (10%)	+ 550 lb (10%)			
Outer Lower Limit	– 180 lb	– 180 lb			

Percent Error Limit

Inner Upper Limit	N/A	N/A			
Inner Lower Limit	N/A	N/A			
Outer Upper Limit	N/A	N/A			
Outer Lower Limit	N/A	N/A			

* Data is only required in each column where the parameter is significant to your desired test environment.

Test Article Interface

	Load Case 1	Load Case 2	Load Case 3	Load Case 4	Load Case 5
	X	X	☐	☐	☐
Design					
Component Models	Yes	Yes			
Assembly Models	Yes	Yes			
Drawings	Yes	Yes			
Comments: Design two test support fixtures for attaching the test samples to the load frame interface hardware. The test support fixtures will consist of…. Drawing attached					
Fabrication					
Component Hardware	Yes	Yes			
Comments: Design and fabricate per attached drawing					
Test Buildup					
Comments: All test support fixtures will be designed to easily adapt to the load frame fixtures. Facility personnel will be responsible for building up the setup for both load cases.					
Requester Supplied Items					
List materials, instruments supplied by Test Requester: Two Assemblies and *X*" diameter shaft					

Operational Requirements

Proposed Test Start Date: Proposed Start Date	Critical Test Start Date: Need Date
Quality Support (Yes/No): No	

Data Acquisition and Recording

Number of Channels: 32	Video Recording (Yes/No): No
Sampling Rates: 10 SPS	Photographic Film (Yes/No): Yes
Real-Time Data Processing (Yes/No): No	High Speed/Low Speed: N/A
Data File (ASCII/Excel): Excel	Plots (Yes/No): Yes

Data

Temperature ☐	Load X	Deflection X	Pressure ☐	Time X	Strain ☐

Instrumentation Provided by Test Requester:

None

Other Information

List any other information pertinent to the test:

Appendix E Customer Feedback

TEST CUSTOMER FEEDBACK							
Product (Test Title):					**Facility:**		
File Number:		**TD:**			**Test Date:**		
	SCORE (Check or Click on Box)						
	Poor					Excellent	
SCHEDULE:	**1**	**2**	**3**	**4**	**5**	**N/A**	
1. Was the test initiated and completed to meet your requirements?	☐	☐	☐	☐	☐	☐	
2. Were we able to accommodate your requested schedule changes?	☐	☐	☐	☐	☐	☐	
COST:							
3. Was the test performed within estimated budget?	☐	☐	☐	☐	☐	☐	
4. Was the test cost reasonable for the test performed?	☐	☐	☐	☐	☐	☐	
PRODUCT:							
5. Was the provided test data accurate?	☐	☐	☐	☐	☐	☐	
6. Was the test data provided to you in an acceptable format and a timely manner?	☐	☐	☐	☐	☐	☐	
FACILITY (Test Position and Support Hardware):							
7. Did the facility's capability meet the needs of the test requirements?	☐	☐	☐	☐	☐	☐	
8. Was the facility reliable during the test?	☐	☐	☐	☐	☐	☐	
TEST TEAM:							
9. Did you find the test team helpful and knowledgeable in meeting your objective?	☐	☐	☐	☐	☐	☐	
10. Would you consider using this test facility for future tests?	☐	☐	☐	☐	☐	☐	
Note: We are concerned and interested in your comments and would like an opportunity to improve our services.							
Comments/Suggestions for Improvement:							
Customer Name & Organization:							
Return to: Test Director or Survey Manager, Chris Briggs (Christopher.p.briggs@nasa.gov)							